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Teacher Training Module:

Science

Learning Cycle Twenty

Technology in Everyday Life

Sindh Technical Assistance – Development through Enhanced Education Programme (STA-DEEP)

School Education & Literacy Department (SE&LD)

Government of Sindh.

Introduction and Rationale of the Training

Dear Teachers!

Welcome to the School Education & Literacy Department (SE&LD) Government of Sindh's Teachers Continuous Professional Development (CPD) Program. This school Cluster-based Teachers' Continuous Professional Development (CPD) program has been developed and is being implemented under the revised School Clustering Policy of 2021 and CPD Model of 2022.

This Content-Based Learning Cycles (CBLCs) series, consisting of cycles 11 to 20, has been developed to further enhance your knowledge and skills in content-based classroom teaching practices. The initial 10 Learning Cycles (LCs) focused on improving pedagogical skills to create interactive, participative, and enjoyable classrooms for students. Building upon these skills, CBLCs 11 to 20 will provide learning opportunities in Mathematics, Science, English, Urdu, and Sindhi for students in grades 1-8 will equip you with modern teaching strategies and subject knowledge to effectively manage classroom situations.

CPD Program vision

The CPD program aims to improve the quality of teaching practices in schools all over Sindh so that students become active and collaborative learners, problem solvers, and critical thinkers who approach tasks creatively and confidently. These CBLCs would help students clearly understand the subject knowledge and connect learned knowledge and acquired skills to the world around them. To make this possible, teachers must be better prepared for the classroom teaching requirements of pedagogy and the subjects' content. Moreover, this program provides specialised training to teachers at the school level through School Cluster-based CPD to make an impact and substantially increase students' learning outcomes.

CPD Program Teaching Philosophy

The CPD training sessions, including this one, adhere to a participatory teaching philosophy. This approach encourages participants to actively engage in collaborative learning while fostering self-reflection and peer reflection, ultimately creating a community of practice. The main goal is to enhance teaching practices and promote an understanding of the subject content theory and the strategies that enable students to confidently and effectively apply the learned knowledge in their daily lives.

Supporting You

The training module is designed to support you in your classroom teaching instruction practices. It will introduce you to the subject content and some approaches for use in the classroom. This will make your teaching more manageable and help you grow as a skilled teacher.

Online CPD portal for teachers

An online CPD portal has been developed for teachers to ask questions to experts, exchange ideas, and share personal learning experiences and difficulties in rolling out the CBLCs. The online CPD portal would help teachers connect with other teachers from all the districts and subject experts to share and learn as a community of teachers. Online portal: https://stadeep-cpd.com/

Note: CBLCs have been developed in alignment with the School Education & Literacy Department (SE&LD), Government of Sindh notified curriculum and textbooks of English subject from grades 1-8 under STEADA and PITE supervision. English textbooks of Grade 1-8 have been used in this LC as a reference.

CBLCs: 1-20: Please refer to the last page of this LC to see the complete list of topics for 1-20 LCs.

Acknowledgement

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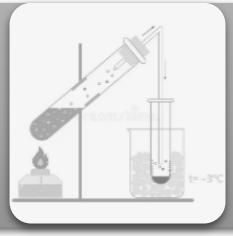
Learning Objectives: By the end of the session, the teachers will be able to:

Integrate scientific concepts/ STEM in daily life to improve the quality of their own life and lives of others



Design a model of a bookshelf /chair using the given specifications e.g. can sustain a given weight, space, materials).

Session Plan

Instructional strategies/activities

Time	Objective/purpose of the activity	Activities/learning experiences	Materials/resources
10 mins	**Welcome** Remind the rules of the workshop. The facilitator will help participants connect with their experience of the last learning cycle	Quick recall of the rules of the workshop. Ask each participant to share one key takeaway from classroom implementation of the previous learning cycle "Human Organ Systems".	Sticky notes/paper chits
10 mins	**Warm-up**  The facilitator aims to connect this LC with the Cross Cutting Element- STEM	The facilitator will recall the LC 10 on "Cross Cutting Element: STEM".Then pose a question, 'What are the disciplinary connections in the cotton ball challenge?' Ask participants to identify technology in the shown pictures: 	LC 10

<table>
<tr>
<td></td>
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</tr>
<tr>
<td>10 mins</td>
<td>Input
 
Facilitator will engage the participants in the discussion and reflect on the topic.</td>
<td>Facilitator will facilitate discussion referring to the ‘Make it STEM Template’ with special emphasis on science and mathematics connections with technology for conveniently solving everyday tasks/problems using engineering design process by showing figure 1 and connecting back to the Cotton Ball Challenge:

<table>
<tr><th colspan="2">Make it STEM: Cotton Ball Challenge</th></tr>
<tr><td colspan="2">Team Members:</td></tr>
<tr><td>Context:</td><td>Science &/ Math Content:</td></tr>
<tr><td>Engineering Design Process:</td><td>Evidence-based Reasoning:</td></tr>
<tr><td>Communication:</td><td>Teamwork:</td></tr>
</table>

Figure 1. ‘Make it STEM Template.

Facilitator will also refer to the NCP (2022-2023), apply the science of materials and design a chair / bookshelf (as given in grade 5).</td>
<td>Multimedia, Board, Marker</td>
</tr>
<tr>
<td></td>
<td>Practice</td>
<td>The facilitator will introduce the STEM challenge that is posed by the Pehli Kiran Schools (PKS) who provide schooling to katchi abadis in Islamabad. PKS has invited you to work in teams and</td>
<td>Handout 20.1 and 20.2</td>
</tr>
</table>

45 mins	 Facilitator will engage participants in a STEM challenge.	design a sustainable piece of furniture (chair) that can be used at PKS. Teachers will be divided in four teams and would be required to work together in their respective teams. Each team will be provided with the handout 20.1 and handout 20.2 and discuss with their team and respond to the questions: • Who needs the solution to this problem (client)? • What and why does the client need a solution to this problem? • Who are the end users? • Why is the problem important? • What are the criteria (requirements) of the solution? • What are the constraints (limits)? Now, that the teams have undergone problem scoping, they will be engaged in identifying: • What kind of background knowledge is needed to solve the problem? • What science/mathematics knowledge will be needed? • What materials will be needed? • What has already been done to solve the problem? • What products fill a similar need? • How should we measure improvement? Next, the teams will begin ideation. Discuss and develop multiple possible solutions and: • Consider trade-offs. • Choose a solution that is worth trying.	Materials: Cardboard sheets, cutter, meter rod/measuring tape

		• Develop plan for this solution (blueprint, cost sheet/materials needed, sketches of prototype). Then, the teams will try their solution and: • Consider potential risk and how to optimize work, • Use criteria, constraints, and trade-offs from problem/plan to build a prototype (a testable representation of a solution), model, or product Once teams have tried out their prototype design, they will test their prototype and: • Consider testable questions or hypotheses. • Develop experiments or use rubrics to know if the solution meets the stated criteria, constraints, and needs. • Collect and analyze data Afterward, teams will decide whether solution is good enough and consider responding to these question to select and redesign: • Are users able to use the design to help with the problem? • Does your design meet the criteria and stay within the constraints? • How could your design be improved based on your test results and feedback from client/user? Finally, teams will communicate their solution to client with evidence-based reasoning. Facilitator and teachers will use a rubric (handout 20.2)	

15 mins	**Conclusion**  The facilitator will provide guiding prompts to participants to summarize their learning.	The facilitator will provide guiding prompts to participants to summarize their learning: a) How did the context of your local problem help you to engage with the problem? b) How did communication and collaboration/teamwork workout during this STEM challenge? c) Were you able to apply STEM knowledge, skills and attitudes to this challenge? ○ If yes, how? ○ if no, how can we ensure meaningful integration of STEM in the given challenge?	Sticky notes/paper chits
30 mins	**Assessment**  Facilitator will assess teacher teams on their final report	Teacher teams will write a report on their STEM challenge. Remind them to explain in 1-2 paragraphs (a paragraph is at least 3-5 complete sentences), explain what they have done for each heading using complete sentences. Keep in mind the Rubric as you write your report so you know what I am looking for. Also answer the questions associated with the cardboard chair design challenge.	

Handout# 20.1

Cardboard Chair Design STEM Challenge

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The Pehli Kiran Schools (PKS) who provide schooling to katchi abadis in Islamabad invites you to work in teams and design a sustainable chair that can be used at PKS using one material (cardboard) and tools like cutter, meter rod only.

Submit your cardboard chair prototype design report with :

- A photo of your chair prototype
- Description of your sustainable chair prototype reflecting the following criteria:
  - Occupies minimal space
  - Serve the purpose (be a functional chair)
  - Be to scale
  - Reflect essential design elements i.e., interlocking shapes for support, angles and proportions
  - Reflect structural features i.e., provide strength and durability, functionality, withstand expected forces and load requirements, comfort/ergonomics.

Handout# 20.2

Make It STEM Template
Cardboard Chair Design Challenge

<table>
<tr><td colspan="2">STEM LO: Design a sustainable piece of furniture (Chair)</td></tr>
<tr><td>Context: For an under-resourced school, design a chair.

Criteria: This chair must fulfill the following:
• occupies minimal space,
• Serve its purpose i.e., ` be functional (chair)
• Be to scale
• Reflect essential design elements i.e., interlocking shapes of support, angles and proportions
• Reflect structural features i.e., provide strength and durability, functionality, withstand expected forces and load requirements, comfort/ergonomics.
Constraints:
• Use the provided corrugated sheets only
• Cutter/a pair of scissors
• Complete EDP in 40 minutes</td><td>Science & /Math Content:
• Apply the science of materials, forces, load distribution.
• Apply the mathematics concepts of shapes, angles, proportions, and scale</td></tr>
<tr><td>Engineering Design Challenge (EDP): In teams:
• Define the problem
• Learn about the science and math needed to respond to the problem
• Plan and ideate various solutions. Select the most promising one
• Try and test the designed prototype
• Decide whether the prototype is good enough or needs some re-design
• Communicate the prototype design to all teams using the evidence -based reasoning template</td><td>Evidence-based Reasoning (EBR):
Each team will use EBR to demonstrate:
• essential design elements
• structural features</td></tr>
<tr><td>Communication: Each team will:
• Showcase their testable prototype
• Use evidence-based reasoning to demonstrate essential design elements and structural features of their prototype.</td><td>Teamwork: The EDP will provide opportunities of working in teams, using 4 Cs (communication, collaboration, creativity and critical thinking)</td></tr>
</table>

Handout# 20.3

RUBRIC TO ASSESS STEM LEARNING

Note: Look for evidence of each sub-category of a criterion. Score 1, 2, 3, 4, or 5 according to the scale:

1=beginning, 2=developing, 3=proficient, 4= highly proficient, 5=advanced

CRITERIA	STANDARDS				
	1	2	3	4	5
Define the Problem (10 points)					
1. Carefully analyze the problem and fully describe the problem in your own words.					
2. Identify project criteria and constraints					
Generate the Concepts (20)					
1. Conduct relevant research on scientific principles and topics related to the project criteria and constraints					
2. Brainstorm numerous ideas, responses, solutions, etc.					
3. Create sketches that are clear, unique, and/or unusual					
4. Work with team members to explore many possible solutions, while giving and accepting feedback on ideas					
Develop a Solution (15)					

1. Systematically evaluate the team's many solutions to determine which design or combination of designs best meets the criteria and constraints of the project.					
2. Justify the chosen solution based on the criteria and constraints and the relevant scientific principles.					
3. Keep detailed records and sketches of the design possibilities, plans, and revisions					
Plan, Try, and Test Prototypes (15)					
1. Persevere to create a prototype					
2. Test and revise the prototype to make sure that it meets project criteria and constraints.					
3. Creatively, responsibly, and conservatively use materials and resources.					
Evaluation and Redesign of the Solution/prototype (20)					
1. Analyze data from tests to determine the similarities and differences among several design solutions and identify the best characteristics of each.					
2. Self-assess the prototype and analyze all design flaws or problems					
3. Suggest multiple solutions to problems or multiple ways to improve the function or quality of the prototype.					
4. Identify ways the creation of the prototype has potential impacts on people and the natural environment.					
Total Score:					

Reference: https://stemteachers.asu.edu/stem-lesson-plans/cardboard-furniture-design-challenge

Additional Resources

- https://stao.ca/resource/the-cardboard-chair-challenge-grade-7/
- https://stemteachers.asu.edu/stem-lesson-plans/cardboard-furniture-design-challenge

For reference:

List of 1-20 LCs topics

Learning Cycles (LCs)	Topics
LC-1	Orientation to Science
LC-2	Food and Health
LC-3	Ecology
LC-4	Matter and its States
LC-5	Mixture and Compound
LC-6	Force and Machines
LC-7	Forms of Energy
LC-8	Heat and Temperature
LC-9	Earth and Space
LC-10	STEM
LC-11	Sound
LC-12	Electricity
LC-13	Atomic Structure
LC-14	Microorganisms
LC-15	Pollution
LC-16	Light
LC-17	Chemical Equation
LC-18	Cellular Organisation
LC-19	Human Organ Systems
LC-20	**Technology in Everyday Life**

For reference:

List of Resource Items for LCs (11-20)

Items	No. of items	LC-11	LC-12	LC-13	LC-14	LC-15	LC-16	LC-17	LC-18	LC-19	LC-20
Sticky notes	3 set	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A4 Paper	1 set	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pencils	12	✓				✓	✓	✓	✓	✓	✓
Thumb pins	1 box	✓				✓					
Balloons	12	✓									
Wooden blocks	1	✓									
Blind fold ,	2	✓									
Board marker,	5	✓									

Speaker	**1**	✓									
Plastic ruler	**2**	✓									
Metallic ruler	**4**	✓									✓
Rubber band	**1 packet**	✓									
Wooden ruler	**2**	✓									
Human ear structure	**1**	✓									
Aluminum foil sheet	**7 meter**	✓					✓				
Card stock or construction paper	**12**	✓									
Straw	**24**	✓								✓	

Ping pong ball	**5**	✓									
Bell	**2**	✓		✓							
Bucket or Tub	**2**	✓									
Chart	**24**		✓	✓	✓	✓	✓				
Lemon	**6**		✓								
Paper clip	**2**		✓								
Copper wire	**1 fold**		✓								
Comb	**1**		✓								
Battery	**5**		✓								
Small bulb / Led light	**3**		✓								

Marker	**10**			✓	✓	✓					
Chart of atomic structure	**1**			✓							
Agar plates	**2**				✓						
Yeast	**1 small packet**				✓						
Tap	**2**	✓				✓	✓				
Clear plastic	**2 pieces**					✓					
Mirrors	**2**					✓					
Wax paper	**2 pieces**					✓					
Torch / laser	**3**					✓					
Paper bags	**4**									✓	
1 litter bottles	**2**									✓	
Cardboard	**2 box**										✓
Cutter	**3**										✓

Meter tape	**3**										✓

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